EXAM 2 | GABRIEL STREITMATTER

I CERTIFY THAT I HAVE NOT USED ANY UNAUTHORIZED ASSISTANCE OR MATERIALS IN THE TAKING OF THIS EXAMINATION

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NAME (PRINT)

Gabe Streitmatter
SIGNATURE

3/25/20
DATE

Q1 FALSE

Q2 FIGURE 2

Q3 TRUE

Q4 FALSE

Q5 a) ROLLED THREADS

Q6 c) APPLYING FRONT AND/OR BACK TENSION
d) REDUCING FRICTION

Q7 FALSE

Q8 SINCE UPSETTING OCCURED WITH THE WORKPIECE AT AN ELEVATED TEMPERATURE BUT COLD DIES, THE PORTIONS OF THE WORKPIECE IN CONTACT WITH THE DIES COOLED FASTER. SINCE MATERIAL FLOW IS GREATER AT HIGER TEMPERATURES, THE WORKPIECE SECTIONS IN CONTACT WITH THE DIES EXPANDED LESS.

ALSO, FRICTION AT THE WORKPIECE DIE INTERFACE CAUSED THE PORTION OF THE WORKPIECE IN CONTACT WITH THE DIE TO INCURR MORE RESISTANCE TO EXPANSION. (I.E. THE CENTER PORTION EXPANDED MORE)

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$\boxed{Q2}$ 304 SS $\begin{cases} K = 1275 \text{ MPa} \\ n = 0.45 \end{cases}$ $D_0 = 0.012\text{ m}$

$D_f = 0.008\text{ m}$

ASSUME: NO FRICTION OR REDUNDANT WORK $V = 0.7\text{ m/s}$

$\boxed{\text{PART 1}}$

$$\overline{\sigma_f} = \frac{K\varepsilon_1^n}{n+1} = \frac{(1275)\ln\left(\frac{(0.012)^2}{(0.008)^2}\right)^{0.45}}{1.45} = 800.175\text{ MPa}$$

a) $F = \overline{\sigma_f} \ln\left(\frac{(0.012)^2}{(0.008)^2}\right) \frac{\pi}{4}(0.008)^2 = \boxed{32.6\text{ kN}}$

$\text{POWER} = F \cdot V = (32.6\text{ kN})(0.7\ \frac{m}{s}) = \boxed{22.8\text{ kW}}$

b) MAX DRAWING/PASS: $\sigma_d = \overline{\sigma_f} \ln(A_0/A_f) = S_y$

$\ln(A_0/A_f) = S_y/\overline{\sigma_f} = 1$ ~ ASSUMPTION

$\boxed{\text{PART 2}}$

$A_0/A_f = e^1 \rightarrow \frac{A_f}{A_0} = e^{-1} \rightarrow \frac{A_f - A_0}{A_0} = e^{-1} - 1$

$\frac{A_0 - A_f}{A_0} = 1 - e^{-1} = 63\% \rightarrow D_f^2 = D_0^2 - 0.63 D_0^2$

$\rightarrow \boxed{D_f = 7.28\text{ mm}}$

$\boxed{\text{PART 3}}$ $P_{ACTUAL} = 1.35 P_{IDEAL} = 1.35(22.8) = \boxed{30.8\text{ kW}}$

Q3

$L = 0.15m \quad D_o = 0.05m \quad D_f = 0.03m$

$S_y = 17MPa \quad \alpha = 90° \quad a = 0.8 \quad b = 1.5 \quad V = 380 \frac{mm}{min}$

a) $R_e = A_o/A_f = \frac{\frac{\pi}{4} D_o^2}{\frac{\pi}{4} D_f^2} = \frac{(0.05)^2}{(0.03)^2} = \boxed{2.78}$

b) $\varepsilon_1 = \ln(R_e) = \boxed{1.022}$

c) $\varepsilon_x = a + b\varepsilon_1 = 0.8 + 1.5(1.022) = \boxed{2.33}$

d) $P = S_y\left(\varepsilon_x + \frac{2L}{D_o}\right) = 17\left(2.33 + \frac{2(0.15)}{0.05}\right) = \boxed{141.7 MPa}$

e) $F = PA_o = (141.7)\frac{\pi}{4}(0.05)^2 = \boxed{0.278 MN}$

f) = $P_{OWER} = F \cdot V = (0.278 MN)\left(0.38 \frac{m}{min}\right)\left(\frac{min}{60 s}\right)\left(\frac{1000 kN}{MN}\right)$

$\boxed{P_{OWER} = 1.762 \text{ kW}}$

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Q4 $W = 0.6\,m$ $K = 1275$ $n = 0.45$ $h_o = 0.026$

$R = 0.42\,m$ $\omega = 75$ RPM $h_f = 0.020$

Part 1 $F = LW\bar{\sigma}_f'$

$L = \sqrt{0.42(0.026 - 0.020)}$

$L = 0.0502$

ASSUMING LOW μ

$$\bar{\sigma}_f' = \frac{K\varepsilon^n}{n+1}\frac{2}{\sqrt{3}} = \frac{2}{\sqrt{3}}\frac{1275\ln\left(\frac{0.026}{0.020}\right)^{0.45}}{1.45}$$

$$\bar{\sigma}_f' = 556\text{ MPa}$$

$$F = (0.0502)(0.6)(556) = \boxed{16.75\text{ MN}}$$

$$T_{PER/ROLL} = \frac{FL}{2} = \frac{(16.75)(0.0502)(1000\frac{kN}{MN})}{2} = \boxed{420\text{ kN}\cdot m}$$

$$P_{OWER} = 2T\omega = 2(420\text{ kN}\cdot m)\left(75\frac{rot}{min}\right)\left(\frac{min}{60\,s}\right)\left(\frac{2\pi}{rot}\right) = \boxed{6603\text{ kW}}$$

Part 2 $\Delta h = \mu^2 R \rightarrow \mu = \sqrt{\Delta h / R}$

$$\mu = \sqrt{\frac{26 - 20}{420}} = \boxed{0.1195}$$